CRC Report No. 581

(2)

OCTANE REQUIREMENT INCREASE OF 1990 AND 1991 MODEL VEHICLES

June 1992

COORDINATING RESEARCH COUNCIL, INC.
219 PERIMETER CENTER PARKWAY, ATLANTA, GEORGIA 30346

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OCTANE REQUIREMENT INCREASE OF 1990 AND 1991 MODEL VEHICLES

(CRC Project No. CM-124-90/91)

Prepared by the

1990/1991 Octane Requirement Increase Analysis Panel

of the

CRC-Automotive Octane Technology and Test Procedures Group

JUNE 1992

Automotive Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

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I. SUMMARY OF RESULTS

The octane requirement increase (ORI) of 80 1990 and 43 1991 model-year vehicles operated on commercial fuels in customer-like service has been determined. These ORI values were established from the octane number requirements regardless of whether they were determined at maximum- or part-throttle.

At 15,000 miles, the mean ORI of the 1990 vehicles with full-boiling range fuels (FBRU) was 4.4 (R+M)/2 octane numbers, 5.2 Research octane numbers (RON), and 3.5 Motor octane numbers (MON). The ORI of individual vehicles ranged from no increase to 11.1 (R+M)/2 numbers.

At 15,000 miles, the mean ORI of the 1991 vehicles with full-boiling range fuels (FBRU) was 3.3 (R+M)/2 numbers, 4.1 RON, and 2.6 MON. Individual vehicle ORI ranged from no increase to 9.2 (R+M)/2 numbers.

As opposed to a number of 1989 models submitted which showed a somewhat unusual variation with mileage, the 1990 and 1991 models behaved in the more traditional manner.

II. INTRODUCTION

The need to study octane requirement increase (ORI) with unleaded gasolines became evident in 1970 when manufacturers announced that future cars would require catalytic converters to meet 1975 emissions standards and these vehicles would use an unleaded fuel of at least 91 RON. The Coordinating Research Council, Inc. (CRC) initiated a series of ORI programs in 1971 to study the effects of these vehicle, fuel, and emissions changes. Since that time, manufacturers have made many engine and vehicle changes to meet both emissions and fuel economy standards. Because of these continuing changes and the exclusive use of unleaded gasoline in new vehicles, the ORI programs have been continued.

The ORI data from 1971, 1973 through 1984, and 1988 and 1989 models have been reported in previous CRC publications. [1-13] CRC sponsored a Society of Automotive Engineers (SAE) paper which reported 1985-1988 model data.[14] This report summarizes the results for the 1990 and 1991 model-years.

III. EXPERIMENTAL

A. Vehicles Tested

The 1990 model-year data include 80 vehicles (66 passenger cars and 14 trucks). The 1991 model-year data include the results of 43 vehicles (40 passenger cars and 3 light trucks). These vehicles were not selected to represent the distribution of vehicles for that model year; rather they were voluntary submissions by the participants, which are listed in Appendix A.

B. Mileage Accumulation

Mileage accumulation on the 1990 and 1991 model-year vehicles was conducted in typical customer service or with test cycles replicating customer service. All vehicles used commercially available unleaded gasoline. No attempt was made to segregate laboratory-to-laboratory effects.

C. Reference Gasoline

The octane number requirements of all vehicles were determined with unleaded average sensitivity full-boiling range fuels (FBRU). Vehicles were tested with the 1989/1990 CRC FBRU fuel series, the 1991/1992 CRC FBRU fuel series, or the CRC customer/rater fuel series, which was blended to be similar to the FBRU fuels. The RON and MON properties of the fuels are shown in Appendix C, Tables C-1, C-2, and C-3.

As a very limited number of 1990 and 1991 vehicles were tested with other additional reference fuels, the additional fuels will not be analyzed and the data not shown. Data will be on file with CRC.

D. Test Technique

Octane number requirements were determined under clean conditions (generally under 200 miles) and in intervals (suggested 5,000-mile increments) up to at least 15,000 miles using the CRC E-15-90 and -91 test procedures. Octane number requirements were determined on all vehicles with FBRU or the customer/rater fuels.

E. Data Analysis Technique

As this is a voluntary program, octane number requirements were determined at a variety of mileage accumulation intervals. The RON of these data were plotted at the mileage tested by the participants, and a best-fit curve was generated to obtain an estimate of octane number requirements at 0, 5,000, 10,000, and 15,000 miles. An example of a best-fit curve is shown in Figure 1. Motor octane number requirements and (R+M)/2 requirements were determined from the best-fit curve RON data using the appropriate RON-to-MON conversions tables in Appendix C. Primary analysis will be based upon (R+M)/2 octane numbers. Members of the Analysis Panel are listed in Appendix B.

IV. DISCUSSION OF RESULTS

A. 1990 Model-Year Results

ORI data have been analyzed for 80 1990 model-year vehicles. The mean ORI of these vehicles is 4.4 (R+M)/2 octane numbers, slightly higher than measured for the 1989 fleet. Expressed in terms of RON and MON, the mean ORI is 5.2 and 3.5 octane numbers, respectively, and is shown in Table 1. The ORI of the individual test vehicles ranged from 0 to 11.1 (R+M)/2 octane numbers. While two cars exhibited ORI's of 10.3 and 11.1 and could be considered outliers in some schemes of analysis, they have been included. A histogram of ORI in terms of (R+M)/2 octane numbers is shown in Figure 2.

The mean unweighted octane number requirement of the 1990 ORI data fleet estimated at 15,000 miles was 86.2 (R+M)/2 octane numbers. This compares to a 50 percent satisfaction level of 85.4 (R+M)/2 octane numbers reported in the 1990 CRC Octane Number Requirement Survey [15]. Figure 3 compares the unweighted distribution of 15,000-mile best-fit octane number requirements of the ORI fleet to the weighted distribution of octane number requirements in the 1990 CRC Octane Number Requirement Survey report and shows the distributions to be very similar, but offset from one another. Mean best-fit RON estimates for initial octane requirements and estimates at 5,000, 10,000, and 15,000 miles are shown in Appendix D, Table D-2.

The 1990 model-year data base is sufficiently large to warrant analysis by make, and in several instances by engine type. These data are reported in Table 1, and show that the means and standard deviations of the engine families are the same order of magnitude as for the makes, suggesting that ORI is highly randomized.

B. 1991 Model-Year Results

ORI data have been analyzed for 43 1991 model-year vehicles. The mean ORI of these vehicles is 3.3 (R+M)/2 octane numbers, slightly lower than measured for the 1990 fleet. Expressed in terms of RON and MON, the mean ORI is 4.1 and 2.6 octane numbers, respectively, and is shown in Table 2. The ORI of the individual test vehicles ranged from 0 to 8.3 (R+M)/2 octane numbers. A histogram of ORI in terms of (R+M)/2 octane numbers is shown in Figure 4.

The mean unweighted octane number requirement of the 1991 ORI data fleet estimated at 15,000 miles was 86.1 (R+M)/2 octane numbers. This compares to a 50 percent satisfaction level of 85.7 (R+M)/2 octane numbers reported in the 1991 CRC Octane Number Requirement Survey [16]. Sufficient vehicles are not available in the 1991 ORI data base to warrant a comparison of the unweighted distribution of 15,000-mile best-fit octane number requirements of the ORI fleet to the weighted distribution of octane number requirements in the 1991 CRC Octane Number Requirement Survey. Mean best-fit RON estimates for initial octane requirements and estimates at 5,000, 10,000, and 15,000 miles are shown in Appendix D, Table D-2.

The 1991 model-year data base is sufficiently large to warrant analysis by make, and to separate one engine type. These data are reported in Table 2, and again show that the mean and standard deviation of the engine family are the same order of magnitude as for the make.

The ORI of the 1990 and 1991 vehicles at 5,000, 10,000, and 15,000 miles has been plotted on Figure 5. The results for both years' vehicles are very consistent with past experience [14] and show that about 65 percent of the octane increase occurs in the first 5,000 miles, while between 10,000 and 15,000 miles, the rate of octane increase is less than 0.1 (R+M)/2 numbers per 1,000 miles.

C. Comparison to Previous Years

The following table shows the mean ORI, 95 percent confidence interval, and sample size for the 1980 through 1991 model years for the FBRU fuels.

Model Year	Number of Vehicles	FBRU Fuel ORI-(R+M)/2	95% Confidence Limits
1980	120	4.2	0.4
1981	86	4.3	0.4
1982	115	4.0	0.4
1983	79	3.6	0.5
1984	62	3.3	0.6
1985	40	3.4	0.8
1986	30	2.6	0.8
1987	41	3.3	1.0
1988	34	4.2	1.0
1989	101	3.8	0.5
1990	80	4.3	0.5
1991	43	3.3	0.6

The above data are graphed on Figure 6 which shows the confidence bands on the means to be overlapping in all but one year, inferring the means are from the same population.

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13. Coordinating Research Council, Inc., "Octane Requirement Increase of 1988 and 1989 Model Cars," CRC Report No. 576, August 1991.

14. SAE Technical Paper 892036, "Trends in Octane Number Requirement Increase," September 1989.

15. Coordinating Research Council, Inc., "1990 CRC Octane Number Requirement Survey," CRC Report No. 575, July 1991.

16. Coordinating Research Council, Inc., "1991 CRC Octane Number Requirement Survey," CRC Report No. 580, _____ 1992.

TABLES AND FIGURES

TABLE 1

INITIAL OCTANE NUMBER REQUIREMENT & OCTANE REQUIREMENT INCREASE AT 5,000, 10,000, AND 15,000 MILES

- 1990 MODEL YEAR -

		(R+M)/2				RON				MON			
		Initial	ORI			Initial	ORI			Initial	ORI		
		ONR	5,000	10,000	15,000	ONR	5,000	10,000	15,000	ONR	5,000	10,000	15,000
total	mean	81.85	2.98	4.01	4.35	85.07	3.55	4.75	5.16	78.61	2.42	3.26	3.54
	std dev	3.27	2.02	2.26	2.39	3.88	2.34	2.66	2.82	2.66	1.66	1.89	1.98
Manufacturer A	mean	81.16	2.32	2.79	2.96	84.28	2.73	3.30	3.49	78.03	1.91	2.32	2.44
	std dev	3.96	1.76	2.06	2.13	4.72	2.04	2.42	2.53	3.24	1.43	1.70	1.76
Manufacturer B	mean	83.02	3.27	4.33	4.73	86.47	3.85	5.12	5.60	79.57	2.68	3.52	3.86
	std dev	2.77	1.77	2.00	2.10	3.33	2.05	2.34	2.47	2.24	1.49	1.71	1.74
Manufacturer C	mean	81.68	2.98	4.00	4.35	84.84	3.59	4.74	5.18	78.46	2.45	3.24	3.52
	std dev	3.42	2.20	2.23	2.28	4.04	2.55	2.63	2.70	2.79	1.84	1.86	1.89
Manufacturer D	mean	81.23	3.01	4.34	4.67	84.33	3.56	5.15	5.53	78.11	2.31	3.55	3.82
	std dev	2.53	1.89	2.52	2.84	2.98	2.20	2.94	3.29	2.05	1.45	2.09	2.34
Engine B30	mean	82.56	2.52	3.96	4.82	85.90	3.02	4.76	5.78	79.22	2.06	3.10	3.90
	std dev	2.77	0.73	1.34	1.85	3.35	0.84	1.61	2.30	2.22	0.61	1.22	1.47
Engine B38	mean	84.52	3.32	3.98	4.16	88.30	3.88	4.68	4.90	80.78	2.72	3.24	3.38
	std dev	3.02	1.67	1.92	1.82	3.66	1.97	2.23	2.11	2.44	1.44	1.62	1.54
Engine C31	mean	82.78	2.51	3.64	4.09	86.14	3.17	4.31	4.88	79.36	2.10	2.89	3.26
	std dev	2.85	1.84	1.71	1.86	3.39	2.07	2.03	2.20	2.31	1.52	1.45	1.53
Engine C38	mean	77.47	2.80	4.37	4.77	79.86	3.36	5.19	5.69	75.06	2.36	3.57	3.91
	std dev	2.39	1.31	2.18	2.28	2.75	1.54	2.54	2.68	2.08	1.11	1.77	1.85

TABLE 2

INITIAL OCTANE NUMBER REQUIREMENT & OCTANE REQUIREMENT INCREASE AT 5,000, 10,000, AND 15,000 MILES

- 1991 MODEL YEAR -

		(R+M)/2				RON				MON			
		Initial	ORI			Initial	ORI			Initial	ORI		
		ONR	5,000	10,000	15,000	ONR	5,000	10,000	15,000	ONR	5,000	10,000	15,000
Total	mean	82.79	2.06	3.24	3.32	86.17	2.54	3.70	4.09	79.43	1.51	2.27	2.56
	std dev	2.93	1.40	2.49	1.97	3.61	1.69	2.25	2.36	2.24	1.09	1.45	1.58
Manufacturer A	mean	80.77	1.67	2.70	3.23	83.67	2.07	3.33	4.00	77.87	1.27	2.03	2.47
	std dev	2.68	0.96	1.04	0.69	3.30	1.17	1.25	0.82	1.99	0.73	0.77	0.46
Manufacturer B	mean	84.00	2.25	2.90	3.13	87.70	2.77	3.59	3.86	80.36	1.62	2.17	2.34
	std dev	1.51	1.16	1.23	1.22	1.83	1.43	1.53	1.53	1.19	1.01	0.99	0.98
Manufacturer C	mean	82.16	2.41	4.10	3.97	85.38	2.97	4.44	4.86	78.94	1.82	2.78	3.10
	std dev	2.77	1.51	3.03	2.23	3.39	1.81	2.48	2.64	2.12	1.15	1.62	1.80
Manufacturer D	mean	83.58	1.13	1.79	2.07	87.17	1.42	2.21	2.59	80.07	0.77	1.28	1.56
	std dev	3.68	0.99	1.44	1.58	4.56	1.20	1.77	1.97	2.81	0.71	1.04	1.18
Engine B50	mean	84.00	2.09	3.14	3.51	87.66	2.55	3.82	4.29	80.39	1.52	2.36	2.73
	std dev	1.28	1.77	2.31	2.36	1.48	2.07	2.68	2.70	1.05	1.39	1.80	1.97

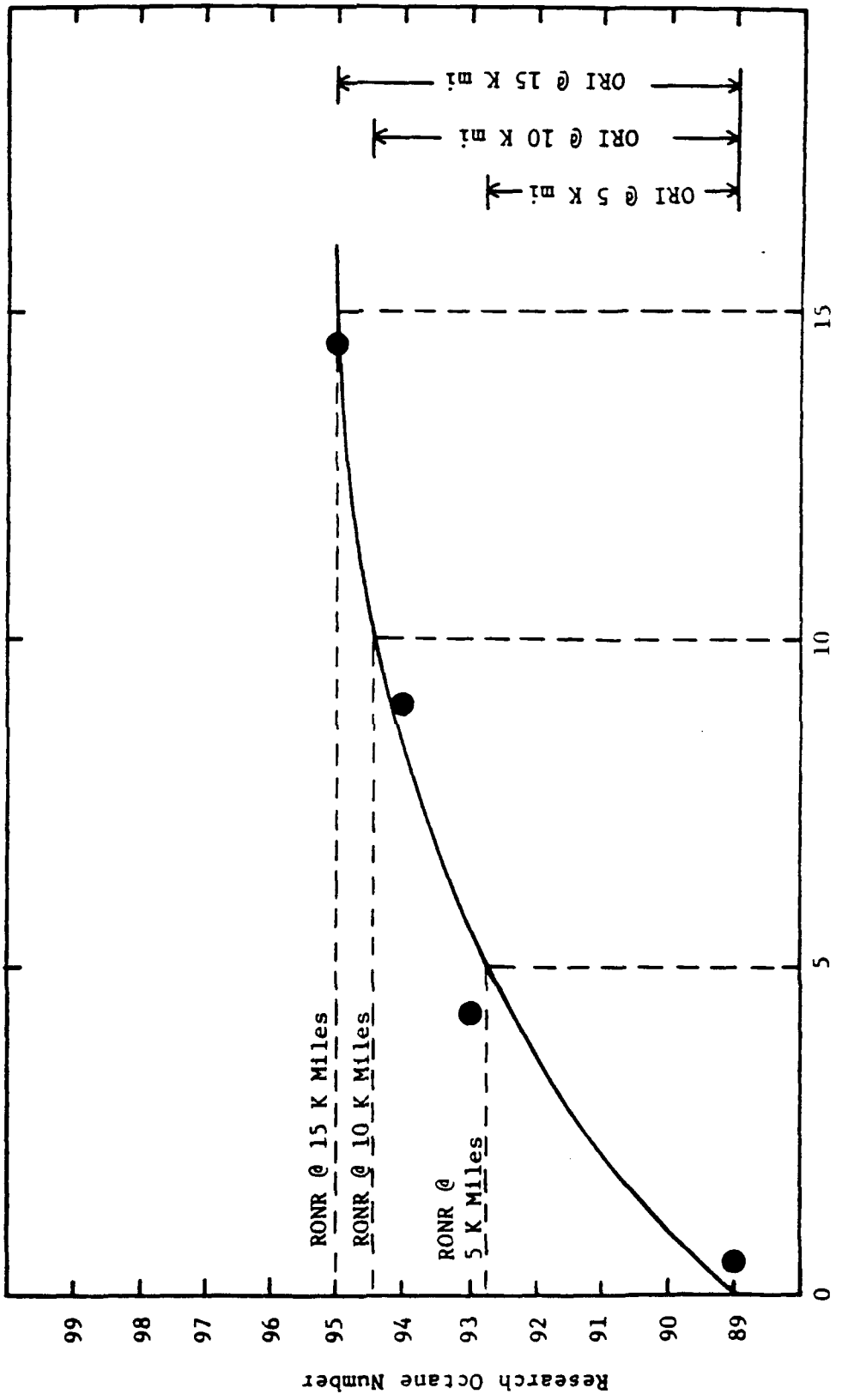


FIGURE 1

BEST-FIT-CURVE ORI ANALYSIS

FIGURE 2

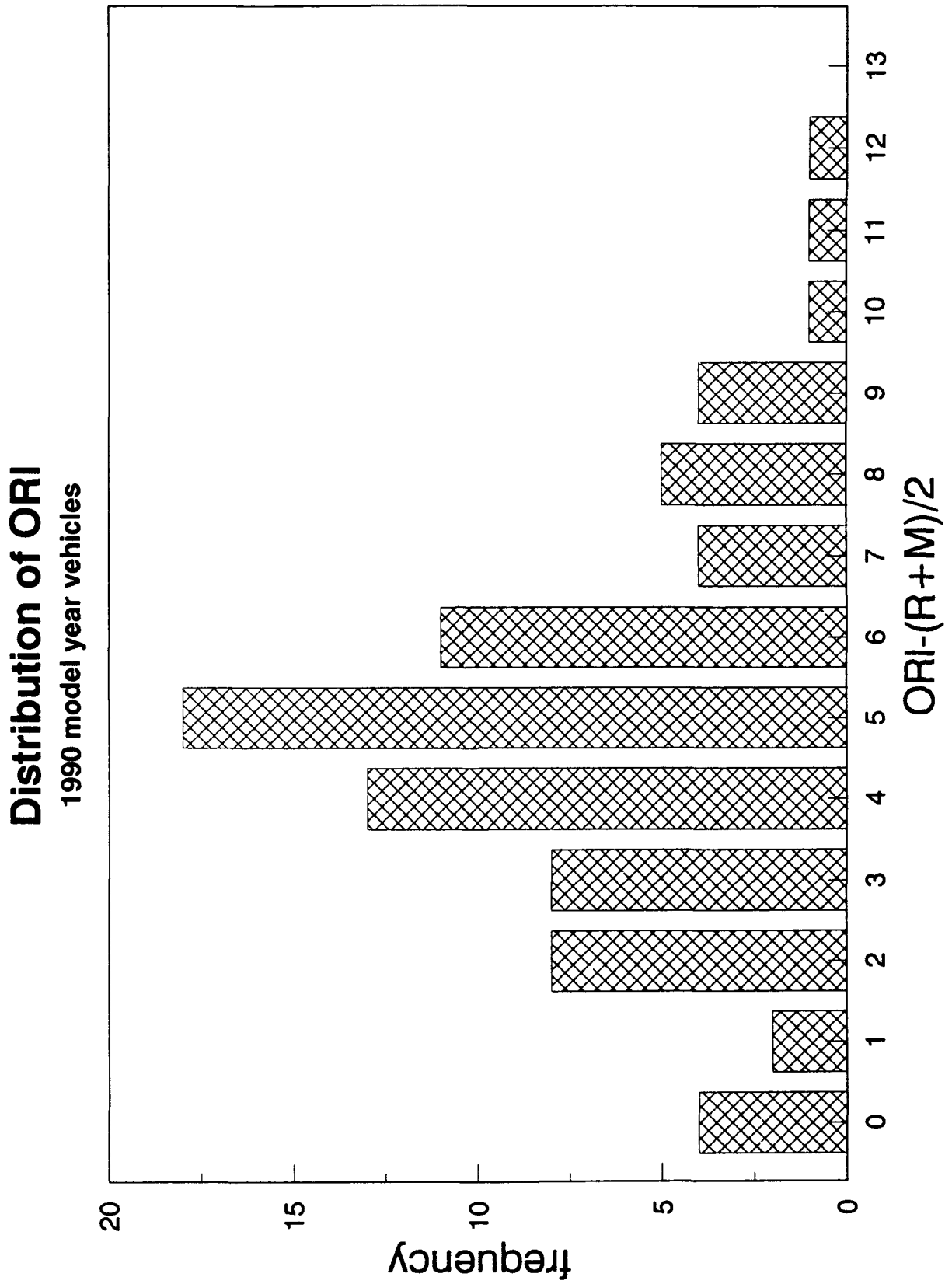

Distribution of ORI
1990 model year vehicles
frequency
0
5
10
15
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
ORI-(R+M)/2

FIGURE 3

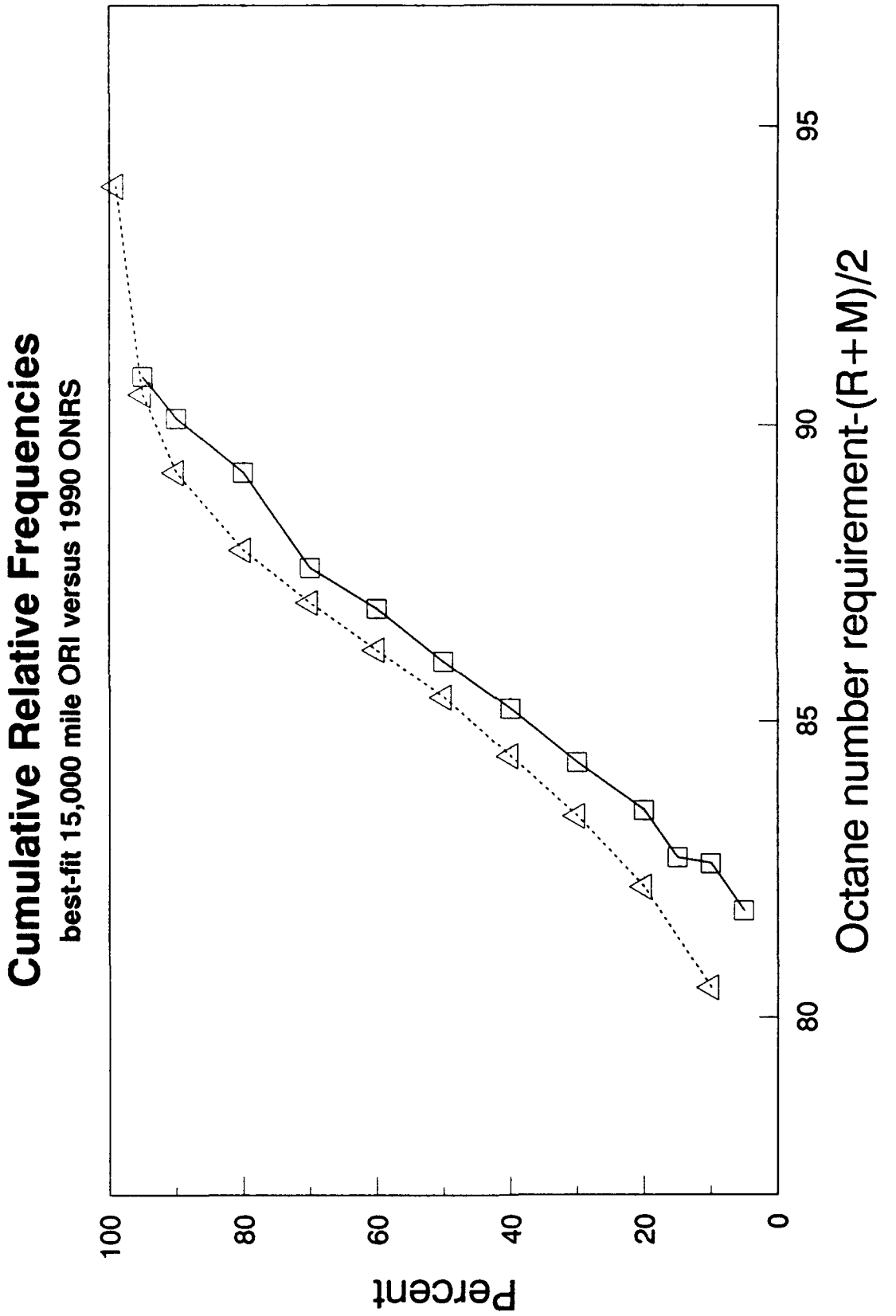

Cumulative Relative Frequencies
best-fit 15,000 mile ORI versus 1990 ONRS
Percent
100
80
60
40
20
0
80
85
90
95
Octane number requirement-(R+M)/2
Best-fit ORI
1990 ONRS

FIGURE 4

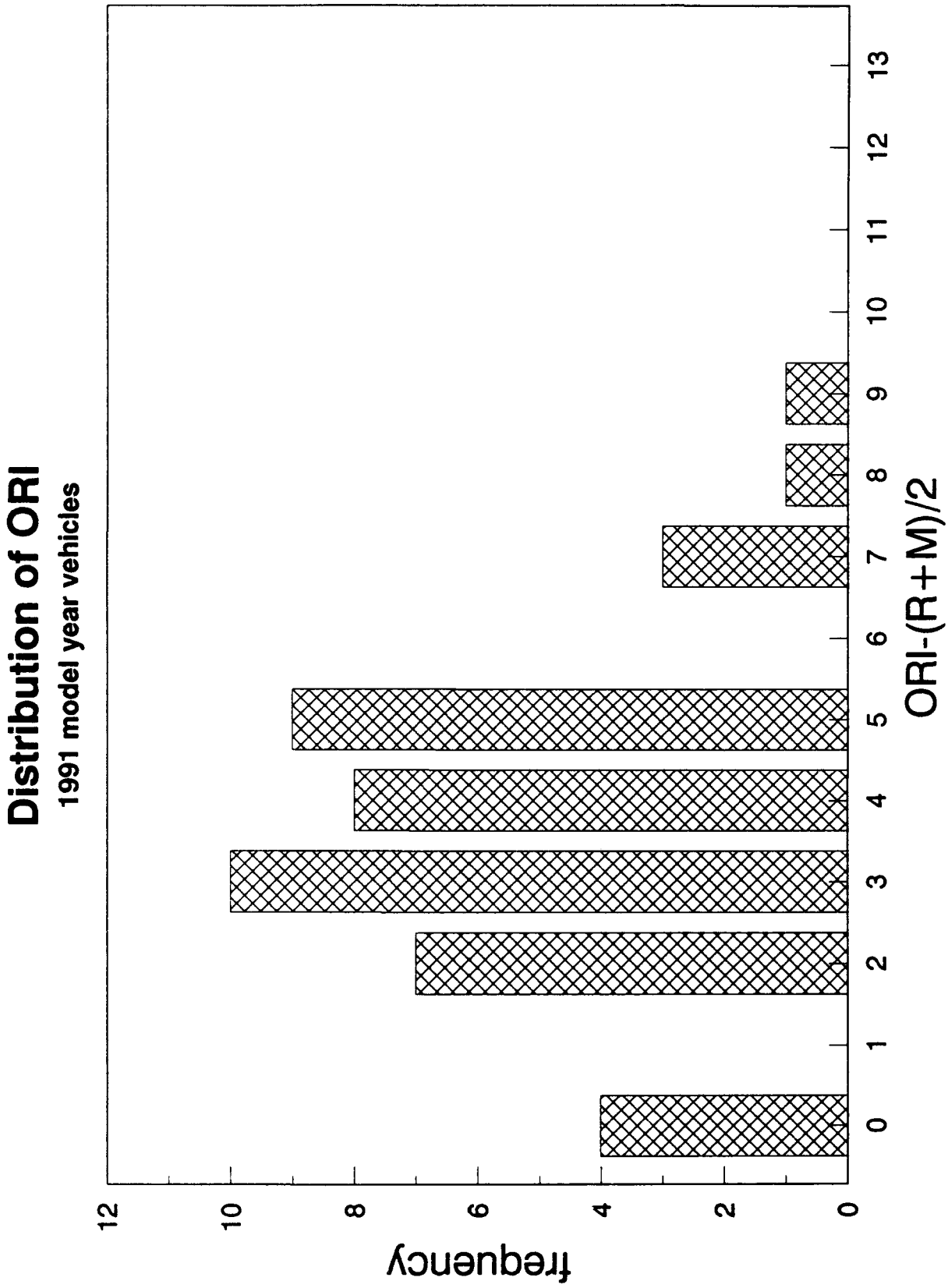

Distribution of ORI
1991 model year vehicles
frequency
0
2
4
6
8
10
12
0
1
2
3
4
5
6
7
8
9
10
11
12
13
ORI-(R+M)/2

FIGURE 5

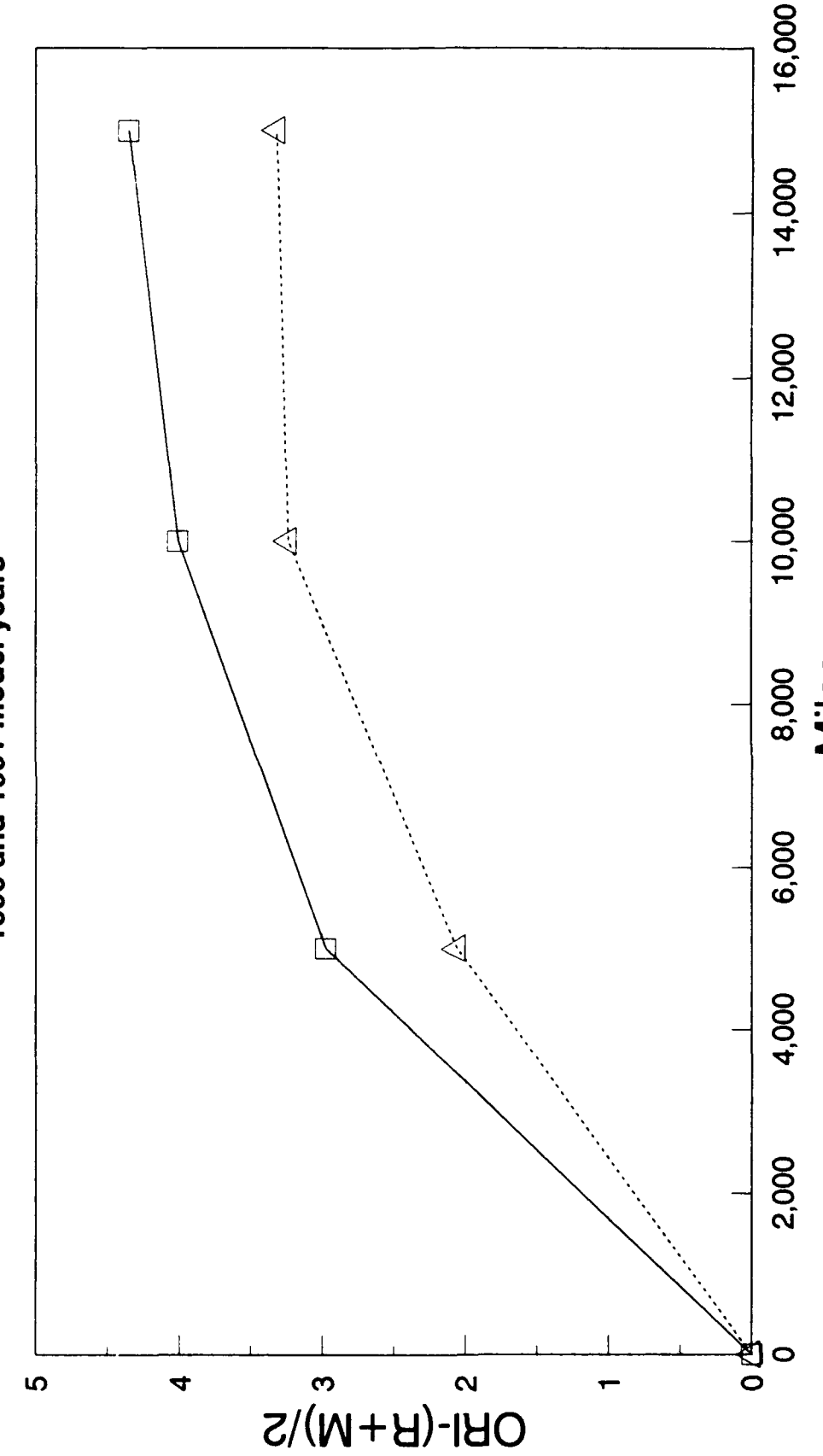
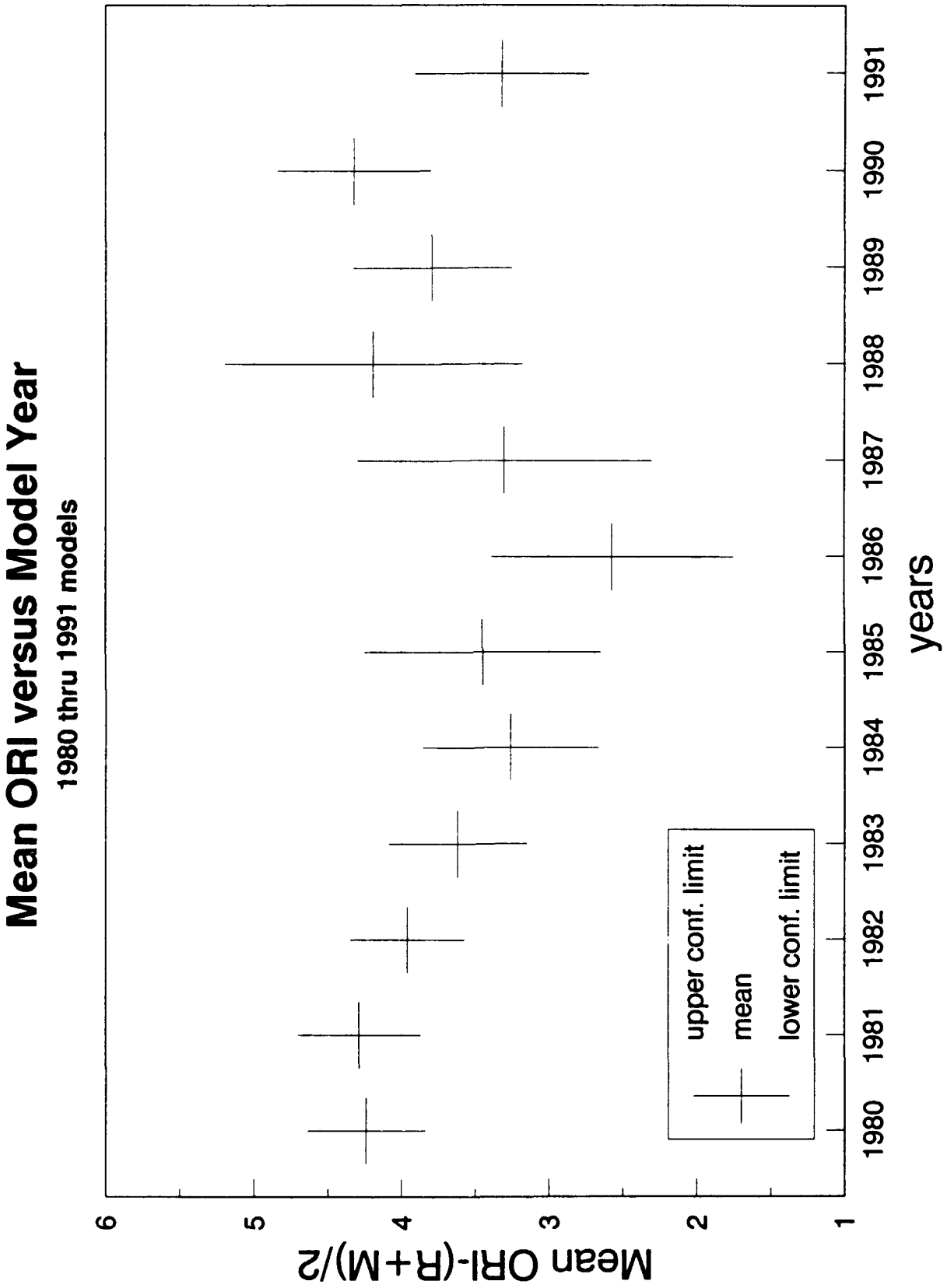

ORI versus Miles
1990 and 1991 model years
ORI-(R+M)/2
0
1
2
3
4
5
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
Miles
1990
1991

FIGURE 6


Mean ORI versus Model Year
1980 thru 1991 models
Mean ORI-(R+M)/2
years
upper conf. limit
mean
lower conf. limit
1
2
3
4
5
6
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991

APPENDIX A

LABORATORIES REPORTING OCTANE REQUIREMENT DATA AT VARIOUS MILEAGES

LABORATORIES REPORTING OCTANE REQUIREMENT DATA AT VARIOUS MILEAGES

Amoco Oil Company
Naperville, Illinois

BP Oil
Cleveland, Ohio

Exxon Research & Engineering Company
Linden, New Jersey

General Motors Research Laboratories
Warren, Michigan

Mobil Research & Development Corporation
Paulsboro, New Jersey

Sun Refining and Marketing Company
Marcus Hook, Pensylvania

Texaco, Inc.
Beacon, New York

Unocal
Brea, California

APPENDIX B

MEMBERSHIP:

1990 AND 1991 OCTANE REQUIREMENT INCREASE DATA ANALYSIS PANEL

1990 AND 1991 OCTANE REQUIREMENT INCREASE DATA ANALYSIS PANEL

NAME	COMPANY
J. C. Callison, Leader	Amoco Oil Company
C. J. Bonés	Mobil Research & Development Company
R. A. Bouffard	Exxon Research & Engineering Company
J. P. Uihlein	BP Oil Company
T. Wusz	Unocal Corporation

APPENDIX C

REFERENCE FUEL DATA

TABLE C-1

OCTANE NUMBERS FOR 1991/1992 CRC FBRU REFERENCE FUELS

Research Octane Number	Motor Octane Number
78	74.5
80	75.7
82	76.8
84	78.0
85	78.6
86	79.3
87	79.9
88	80.5
89	81.2
90	81.8
91	82.5
92	82.8
93	83.5
94	84.3
95	85.0
96	85.8
97	86.6
98	87.3
99	88.1
100	88.9
101	89.7
102	90.5
103	91.3

TABLE C-2

OCTANE NUMBERS FOR 1989/1990 CRC FBRU REFERENCE FUELS

Research Octane Number	Motor Octane Number
80	75.2
82	76.7
84	78.1
85	78.6
86	79.4
87	80.0
88	80.7
89	81.3
90	81.9
91	82.6
92	83.3
93	83.9
94	84.5
95	85.2
96	85.9
97	86.6
98	87.3
99	88.0
100	88.8
101	89.6
102	90.4
103	91.4
104	92.6

TABLE C-3

OCTANE NUMBERS FOR CRC CUSTOMER/RATER REFERENCE FUELS

Research Octane Number	Motor Octane Number
78	73.6
79	74.3
80	75.0
81	75.7
82	76.4
83	77.1
84	77.8
85	78.5
86	79.2
87	79.9
88	80.7
89	81.4
90	82.1
91	82.8
92	83.5
93	84.2
94	84.9
95	85.6
96	86.3
97	87.0
98	87.8
99	88.5
100	89.2
101	89.9
102	90.6
103	91.3

APPENDIX D

OCTANE REQUIREMENT DATA

TABLE D-1

1990 OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUELS

Transmission Codes	Initial	5,000	10,000	15,000
s12s32	81.5	84.4	85.5	86.2
c12a32	79.0	85.2	86.0	86.0
s12s32	80.0	84.6	86.0	86.7
c12a32	80.0	83.0	83.0	83.0
s12sk2	87.0	87.6	87.8	88.0
s13sk2	83.0	87.3	88.0	88.0
s13sk2	84.0	87.0	87.9	88.0
c13aj2	92.0	92.0	92.0	92.0
c13aj2	92.0	92.0	92.0	92.0
c21e92	86.0	89.0	90.0	90.0
c21e92	87.0	89.8	92.0	93.0
c21tx2	83.0	89.6	91.5	92.0
c21tx2	82.0	87.3	88.6	89.0
c21du2	87.0	89.8	90.8	91.0
c21du2	84.0	87.6	88.7	89.0
c21du2	83.5	86.3	89.0	91.4
c21du2	92.0	93.7	94.5	95.0
c21du2	83.0	87.2	90.3	92.0
c21d42	86.0	93.5	95.0	95.0
c21s42	92.5	96.5	96.5	96.5
c21s42	93.0	96.5	97.4	97.5
c21d42	85.0	87.7	88.0	88.0
c21d42	85.0	86.7	88.0	89.0
v21ax2	84.0	86.2	88.0	89.0
p21fn2	86.0	93.7	94.5	94.5
c21fe2	86.0	90.0	91.0	91.0
p21fn2	86.0	93.0	94.4	94.5
c21sr2	92.0	92.0	92.0	92.0
c33nd4	85.0	86.2	87.3	88.0
c32na4	89.0	91.0	91.0	91.0
c33na4	88.0	88.6	88.9	89.0
c33na4	82.0	84.8	87.5	89.5
c31lt2	89.5	92.3	94.4	95.5
c31lt2	83.0	85.0	85.7	86.0
c31lt2	87.0	89.8	92.6	94.6
c31lt2	83.0	86.0	87.0	87.0
c31at2	80.0	83.4	84.9	85.6
c32wt2	82.0	86.0	86.0	86.0
c32wt2	88.0	90.0	90.0	90.0
c31wt2	88.0	90.4	92.5	93.8
c31wt2	86.0	88.4	90.0	90.0
c31at2	85.5	87.4	88.7	90.0
c31wt2	90.0	92.0	92.0	92.0
c33an2	89.0	93.5	95.3	96.0
c34nn2	83.0	93.0	93.0	93.0
c33an2	92.0	93.2	94.3	94.8
c34nn2	85.0	91.0	91.0	91.0
c33cc2	84.0	84.4	84.7	85.0
c34cc2	82.0	83.7	84.8	85.8

TABLE D-1 (Continued)

1990 OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUELS

Transmission Codes	Initial	5,000	10,000	15,000
c34cc2	80.0	84.4	85.6	86.0
c34nc2	76.0	80.3	83.2	84.0
c34nc2	76.0	79.7	81.0	81.0
c34cc2	80.0	85.0	89.0	90.0
c34hc2	81.0	85.0	87.0	87.0
c35c32	85.0	90.3	91.7	92.0
c35c32	90.0	92.1	93.6	94.0
c35c32	90.0	92.1	92.7	93.0
c35c32	92.0	94.2	94.8	95.0
c31jg2	82.0	86.1	87.3	88.0
c31jg2	83.0	88.0	88.0	88.0
c31jg2	85.0	86.0	87.0	87.0
c31jg2	89.0	93.7	95.0	95.0
v36zd2	85.0	89.0	90.0	90.0
v36mz2	80.0	93.0	93.0	93.0
v36mz2	84.0	93.0	94.0	94.0
c60s64	82.0	84.6	86.0	86.0
c62b*4	85.0	85.0	85.0	85.0
c62b*4	86.0	88.0	88.0	88.0
c74pu4	84.0	87.0	89.0	89.0
c76a*3	82.0	85.2	86.4	87.0
c76a*3	84.0	89.5	91.0	91.0
c76b*2	81.0	83.3	85.2	86.0
c76e*2	85.0	86.0	86.7	87.0
c94ev4	85.0	88.5	90.7	91.0
c94ev4	84.0	91.5	94.5	95.0
c94ev4	90.0	94.0	96.5	96.5
c94ev4	88.0	92.6	93.7	94.0
p941r2	81.0	86.0	90.5	93.0
p941r2	79.0	87.0	88.0	88.5
p94ir2	89.0	90.2	91.0	91.0

TABLE D-2

1991 OCTANE REQUIREMENTS FROM BEST-FIT-CURVES - FBRU FUELS

Transmission Codes	Initial	5,000	10,000	15,000
s13sr2	80.0	81.5	83.0	84.0
c12ak2	83.0	86.7	88.0	88.0
c12pc2	88.0	89.0	90.0	91.0
c21ej2	90.5	92.7	94.3	95.6
c21ej2	86.5	90.5	91.5	92.0
c21tx2	87.0	88.5	89.0	89.0
c21fm2	85.0	90.0	91.0	91.0
c21fx2	88.0	91.0	93.0	93.0
c21du2	86.0	89.0	89.0	89.0
v21ax2	87.0	92.0	92.0	92.0
c24pw2	91.0	92.0	92.5	93.0
c21e92	89.0	91.0	92.0	92.0
c22ej2	87.0	88.0	88.6	89.0
c33na4	84.0	85.0	85.7	86.0
v32ud2	80.0	81.7	82.8	83.0
c34wt2	82.0	84.7	87.0	88.0
c33wx4	88.0	88.0	88.0	88.0
c33cl2	82.0	84.8	86.0	86.0
c34cl2	80.0	85.0	86.0	86.0
c34wl2	82.0	84.5	85.5	86.0
c34cc2	87.0	88.3	89.0	89.0
c33cl2	82.0	83.5	84.0	84.0
c35cb2	88.0	92.5	95.5	96.0
c35cb2	88.0	90.3	92.3	93.7
c35cb2	88.0	91.0	93.3	94.0
c31lg2	84.0	85.5	86.0	86.0
c31lg2	80.0	84.6	86.0	86.0
c31be2	89.0	91.5	92.0	92.0
c31be2	88.0	89.5	90.8	91.7
c31be2	88.0	89.5	90.7	91.7
c31be2	87.0	94.0	96.0	96.0
c31be2	89.0	95.4	96.8	97.0
c31be2	86.0	90.6	94.4	96.0
c31be2	91.0	95.5	98.5	99.0
c42a*	86.0	88.8	90.2	90.9
c50a*	91.0	92.2	93.3	94.0
c62c*4	90.5	92.0	93.0	93.8
c62c*4	90.5	90.5	90.5	90.5
c62e*	84.0	85.3	86.2	86.8
c70a*	80.0	83.0	84.0	84.3
c76a*3	92.5	92.5	92.5	92.5
c76a*3	90.0	90.0	90.0	90.0
c94es4	80.0	83.0	84.7	85.0